Key

Section 9.3 – Properties of Logarithms
Day 1

Remember how to simplify these?

1) $x^2 \bullet x^4$ $x^{2+4} = x^6$

2) $\frac{x^5}{x^3}$ $x^{5-3} = x^2$

REMEMBER: Logarithms are exponents

Property I (on calculator)

log 7 .845 log 2 .301 log 14 1.146

What do you notice about log 7 and log 2 in relation to log 14? log 7 + log 2 = log 14

So, log (7 • 2) = log 7 + log 2

When you multiply two powers with the same base, you add the logs.

Logarithm of a Product

$$\log(xy) = \log x + \log y$$

Directions: Use the log of a product property to write the log as the sum of two logs...

example

Ex1) log 6 = log 2 + log 3 Ex2) log 26 = log 2 + log 13

Property II Use your calculator to evaluate:

a) log 22 = 1.342

b) log 2 = .301

c) log 11 = 1.041

What did you notice about log 22 and log 2 in relation to log 11? subtraction

So, $\log\left(\frac{22}{2}\right)$ = log 22 − log 2

Because, LOGARITHMS ARE exponents! When you divide two powers with the same base, you subtract the logs.

Logarithm of a Quotient

$$\log\left(\frac{x}{y}\right) = \log x - \log y$$

Use the log of a quotient property to write the log as the difference of two logs…

Ex1) $\log\left(\frac{3}{2}\right)$ = $\log 3 - \log 2$

Ex2) $\log 2.5$ = $\log\left(\frac{5}{2}\right) = \log 5 - \log 2$

Property III. Use your calculator to evaluate:

$\log 8$ $\log(2\cdot2\cdot2)$ $3(\log 2)$ $\log 2 + \log 2 + \log 2$

$\log 8 = \log\left(2^3\right) = 3(\log 2)$

Logarithm of a Power

$\log_b\left(x^n\right) = n \bullet \log_b x$

Let's try some of these… write these logarithms with the exponent of the product in front of the log.

1) $\log 16 = \log 2^4 = 4(\log 2)$

2) $\log 36 = \log 6^2 = 2(\log 6)$

3) $\log 216 = \log 6^3 = 3(\log 6)$

One more things to remember…

Can you get the results above from other bases, besides base 10? yes!

Let's give it a try☺ Simplify…

$\log_4 4$ = 1 $\log_5 5$ = 1 $\log_5 25$ = 2

How can these help you? You will see in the next problems☺

Break it down!

Now let's try some. Evaluate each log by letting $\log_5 2 = .4307$, $\log_5 3 = .6826$.
Also remember that $\log_5 5 = 1$

1) $\log_5 6$ $= \log_5 2 + \log_5 3$
$= .4307 + .6826$
$= 1.1133$

2) $\log_5 20$ $= \log_5 5 + \log_5 2^2$
$= \log_5 5 + 2(\log_5 2)$
$= 1 + 2(.4307)$
$= 1.8614$

3) $\log_5 25$ $= \log_5 5^2$
$= 2(\log_5 5)$
$= 2(1)$
$= 2$

4) $\log_5 3^5$ $= 5(\log_5 3)$
$= 5(.6826)$
$= 3.413$

5) $\log_5 \left(\frac{3}{5}\right)$ $= \log_5 3 - \log_5 5$
$= .6826 - 1$
$= -.3174$

6) $\log_5 100$ $= \log_5 5^2 + \log_5 2^2$
$= 2 + 2(.4307)$
$= 2.8614$

What if we did these same problems, but let $\log_5 2 = A$, $\log_5 3 = B$ **and** $\log_5 5 = 1$. **How would you answers change??**

1) $\log_5 6$ $= \log_5 2 + \log_5 3$
$= A + B$

2) $\log_5 20$ $\log_5 5 + 2(\log_5 2)$
$= 1 + 2A$

3) $\log_5 25$ $= \log_5 5^2$
$= 2$

4) $\log_5 3^5$ $= 5(\log_5 3)$
$= 5B$

5) $\log_5 \left(\frac{3}{5}\right)$ $= \log_5 3 - \log_5 5$
$= A - 1$

6) $\log_5 100$ $= \log_5 5^2 + \log_5 2^2$
$= 2 + 2A$

Find the logarithm without using your LOG key on your calculator! You must have no logs in your answer. Let log 2 = a, log 3 = b and log 5 = c. Look for base 10 logs !

1) $\log 6$ $= \log 2 + \log 3$
$= a + b$

2) $\log 200$ $= \log 10^2 + \log 2$
$= 2 + a$

3) $\log \left(\frac{3}{2}\right)$ $= \log 3 - \log 2$
$= b - a$

4) $\log 2^7$ $= 7(\log 2)$
$= 7a$

5) $\log 16$ $= \log 2^4$
$= 4(\log 2)$
$= 4a$

6) $\log \frac{1}{9}$ $= \log 1 - \log 3^2$
$= 0 - 2(b)$
$= -2b$